N(021407
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(12) UK Patent Application (19) GB (11) 2 282 295 (13) A

(43) Date of A Publication 29.03.1995

(21) Application No 9419280.4

(22) Date of Filing 23.09.1994

(30) Priority Data
(31) 9319727 (32) 24.09.1993 (33) GB

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(51) INT CL[6]
H04N 9/78

(52) UK CL (Edition N)
H4F FD1B3 FD30B FD30K FD30T2 FHS

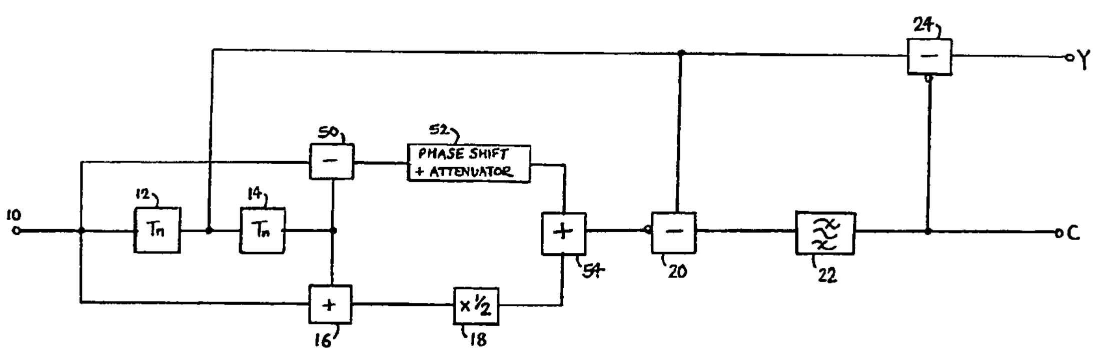
(56) Documents Cited
None

(58) Field of Search
UK CL (Edition M) **H4F FEK FHS**
INT CL[5] **H04N 9/78**
Online databases: WPI

(54) **PAL comb filter**

(57) Comb filtering a composite PAL video signal in a digital line locked environment (H, 2H) is subject to a residual chrominance error, arising from the 25 Hz offset in the sub-carrier. This error is eliminated by subtracting from the original combed signal, a second and different combed signal (50, 52) which is phase shifted and attenuated to represent the residual chrominance error.

Figure 5



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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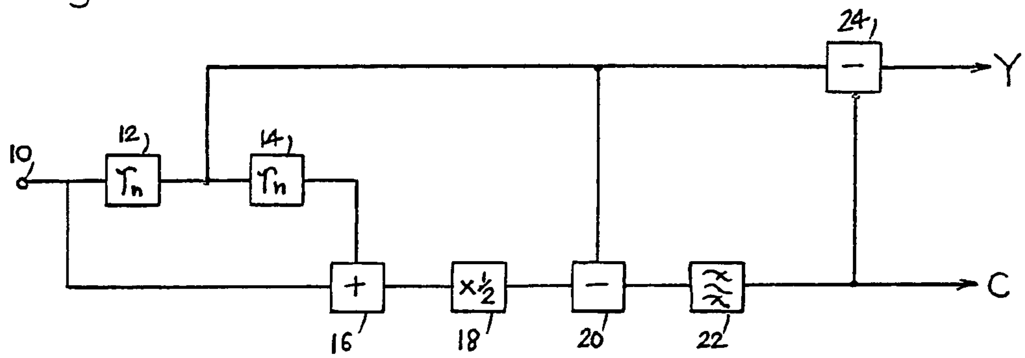
Figure 1



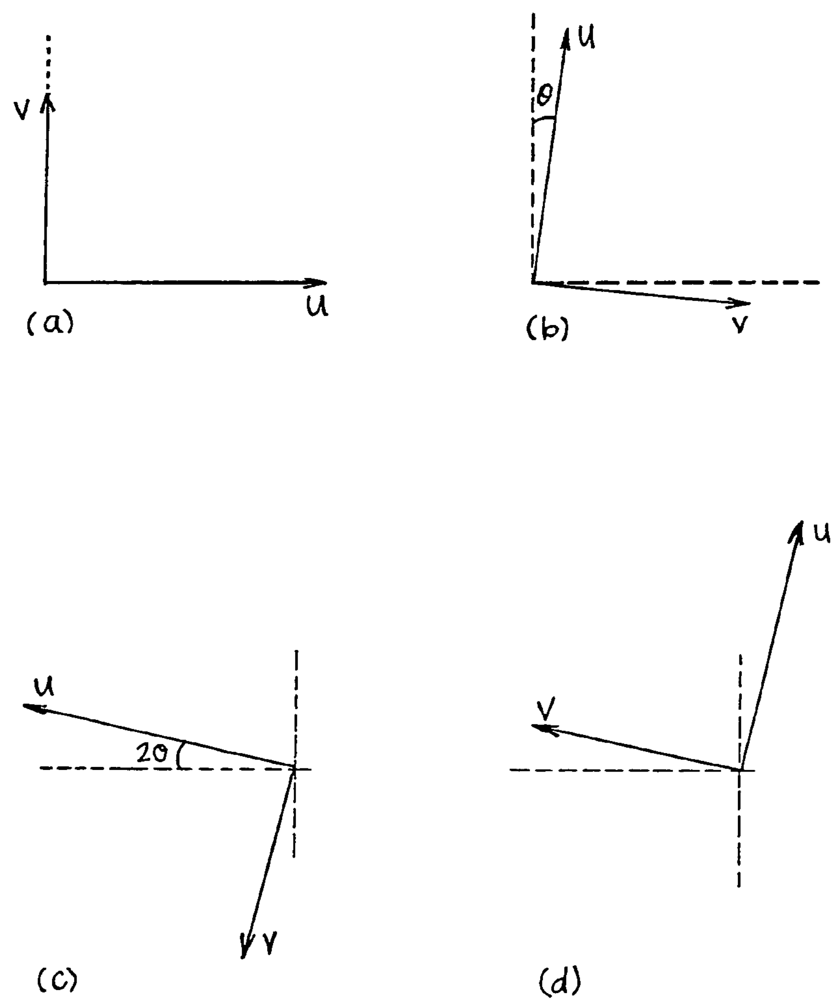
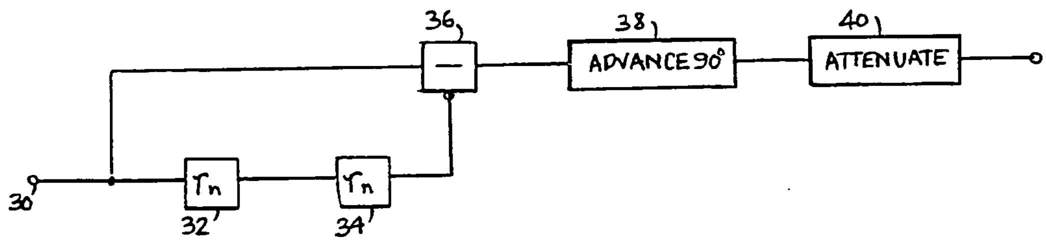


Figure 2

Figure 3



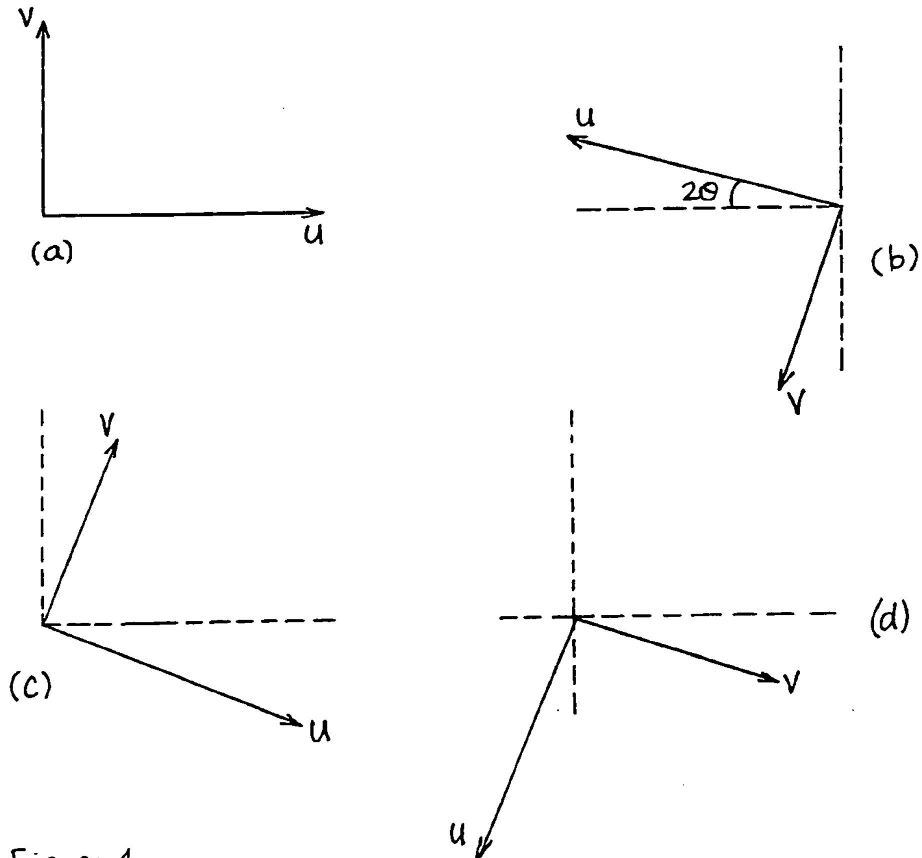


Figure 4

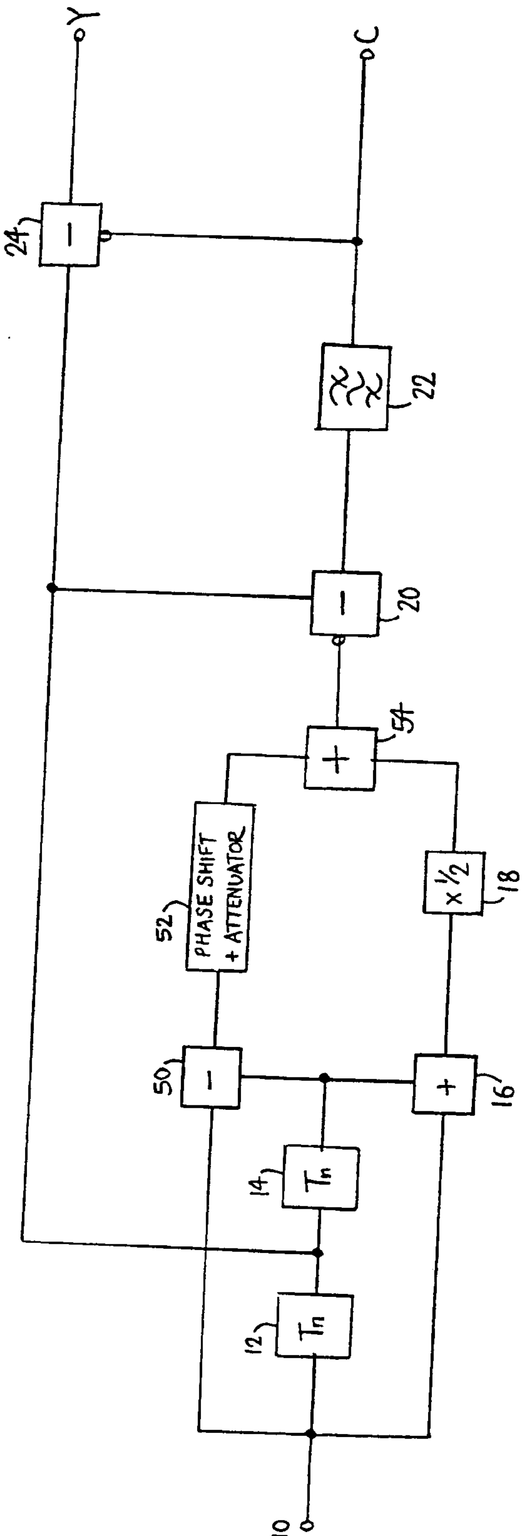

Y
C
24
22
20
54
52
PHASE SHIFT
+ ATTENUATOR
x 1/2
18
50
16
14
12
Tn
Tn
10

Figure 5

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VIDEO SIGNAL PROCESSING

This invention relates to video signal processing and is particularly concerned with the separation of luminance and chrominance information in a PAL colour television signal. The invention has application both in encoding and decoding of PAL signals.

There is a well-known technique for separating the luminance component of a PAL signal which utilises two cascaded delays each of approximately one video line. The input signal and the output from the second delay are summed. Because of the relation between the PAL colour sub-carrier frequency and the line frequency, the phase difference between the input signal and the signal delayed by two lines is approximately 180° so that, in the absence of vertical chrominance detail, the chrominance components cancel in the summing leaving a double amplitude signal consisting substantially of luminance only. This signal can be reduced to unity gain and subtracted from the composite signal at the output of the first delay, to produce a separated chrominance signal. This separated chrominance signal is band pass filtered to the required horizontal chrominance band width and passed to a chrominance channel for further processing. The band pass chrominance signal is subtracted from the component signal at the first delay line output to feed a luminance channel.

It is known theoretically that the optimum delay length for cancellation of chrominance between undelayed and twice delayed signals is not precisely the same as the length of one line. The full equation for PAL sub-carrier frequency is:–

$$283.75 \times \text{line frequency} + 25 \text{ Hz}$$

Because of the 25 Hz offset, the optimum length of delay lines for perfect chrominance cancellation is slightly shorter than one line. An exact line comprises 283.7516 cycles of sub-carrier, whereas optimum cancellation requires 283.7500 cycles. The provision of optimum length

delays is simple in decoders which make use of digital processing at a sample rate of four times sub–carrier frequency. However, in digital equipment using line–locked sampling (as specified in CCIR Recommendation 601) only the exact line length is readily feasible. Line–locked sampling therefore leads to imperfect separation of chrominance and luminance which leads to a number of well–known impairments which are particularly acute when the decoded signal is used for further processing.

It is an object of the present invention to provide improved video signal processing which removes or mitigates the defect associated with comb filtering in a line–locked environment, without substantially increasing the complexity of the circuit.

Accordingly, the present invention consists in video signal processing means for use in the separation of chrominance and luminance information in a PAL colour television signal, comprising a line delay array having a plurality of taps and first combination means serving to generate a first linear combination of delay taps in which chrominance is suppressed, wherein the line delay array is line–locked and said first linear combination therefore contains residual chrominance, characterised in that second combination means are provided to generate a second, independent linear combination of delay taps representative of said residual chrominance and wherein said first and second combinations are mixed at appropriate phase and amplitude to cancel said residual chrominance.

Suitably, the first linear combination comprises the sum of taps separated by two lines and said second linear combination comprises the difference of the said taps, phase shifted and attenuated.

In a further aspect, the present invention consists in a method for removing residual chrominance error from the output of a vertical filter operating at fixed line length, comprising the steps of independently deriving from the taps of the filter a signal representing the residual chrominance error and combining said signal with the filter output in cancellation of the error.

The invention will now be described by way of example with reference to the accompanying drawings in which:–

Figure 1 shows a prior art comb filter;

Figure 2 is a series of UV phase plots illustrating the performance of the filter shown in Figure 1;

Figure 3 is a block diagram illustrating a modification according to the present invention;

Figure 4 is a series of UV phase plots illustrating the performance of the circuit shown in Figure 3; and

Figure 5 is a block diagram of a filter according to the present invention.

There is shown in Figure 1 a known arrangement in which a composite PAL input at terminal 10 is taken through cascaded line delays 12 and 14. The undelayed and two-line delayed signals are combined in adder 16. It will be understood that if the delays differed from true line length by the amount necessary to compensate for the 25 Hz offset described above, there would be complete cancellation of chrominance at the output of adder 16 and, of course, a doubling of luminance. Attenuator 18 returns the luminance to normal amplitude, for subtraction at block 20 from a composite signal taken from the midpoint of delays 12 and 14. The output from subtractor 20 is band passed at 22 to provide a chrominance signal. This signal is subtracted at 24 from the composite signal to provide luminance.

In a digital environment which is required to use line–locked sampling, it is not ordinarily practicable to use "line" delays which depart from true line length. In these circumstances, there will not be complete cancellation of chrominance in the adder 16. This can be seen more clearly in Figure 2 which shows a series of UV plots corresponding to signals at different points in the circuit of Figure 1. Thus, Figure 2a) represents chrominance at the input terminal 10. The effect of a delay can be regarded as a rotation in phase space, with phase reversal on alternate lines for one of the colour

difference signals. Thus, chrominance at the output of the first line delay 12 can be depicted as at Figure 2b). To a first approximation, **U** and **V** have been rotated through 270° and **V** has been reversed. The error arising from the use of an exact rather than an optimum line length delay can be represented as a phase angle shift θ. The chrominance at the output of the second line delay as shown in Figure 2c) involves a rotation through a further 90° plus θ, with reversal of the **U** signal.

It will be seen that the function of block 16 is to add the signals depicted in Figures 2a) and 2c). Because of the error that has been discussed, this addition does not result in complete cancellation but leaves a residual chrominance signal having **U** and **V** components as shown to an enlarged scale in Figure 2d).

Turning now to Figure 3, an arrangement is shown in which a PAL signal at input terminal 30 is taken through line delays 32 and 34. The undelayed and the two line delayed signals are subtracted in block 36. It is convenient at this point to refer to the plots of Figure 4.

Figure 4a) shows the chrominance at the input terminal 30 whilst Figure 4b) shows the chrominance of the two line delayed signal. Thus, Figure 4b) corresponds with Figure 2c). The function of subtractor 36 is to produce a signal having chrominance as shown in Figure 4c). This signal is advanced in phase through 90° in block 38 and attenuated in block 40 to produce an output signal having chrominance as shown in Figure 4d). It will be seen by inspection that the chrominance of this signal is complementary with the residual chrominance error shown in Figure 2d). Addition of the signal generated by the circuitry of Figure 3 will therefore remove the residual chrominance error.

Turning now to Figure 5, there is shown a circuit according to the invention in which this cancellation is achieved. Components which this arrangement shares in common with Figure 1 retain the same reference numerals and need not be described further.

It will be seen that a subtraction is performed at block 50 between the two line delayed and undelayed signals. The resulting signal is phase

shifted and attenuated in block 52 and the result added at block 54 to the original comb output. It will be recognised that the compensatory signal can either be advanced or retarded and added or subtracted, as is more convenient.

It should be recognised that this invention has been described by way of example only and a variety of modifications are possible without departing from the scope of the invention. Thus, there will be a wide variety of other ways in which a signal can be generated which is complementary to the residual chrominance. The described arrangement in which the sum of undelayed and two line delayed signals (with suitable attenuation) is combined with the difference of the same signals phase shifted (and with suitable attenuation) is regarded as but one example of the mixing of two independent combinations of outputs from the same array of line delays.

In a further example, the described circuit can be placed in a signal path preceded by a band pass filter and therefore handling only chrominance and high frequency luminance. The band pass filter 22 will then not be necessary. The chrominance signal from this path, possibly after still further processing outside the scope of this information, is then subtracted from a parallel signal path containing full luminance information.

CLAIMS

1. Video signal processing means for use in the separation of chrominance and luminance information in a PAL colour television signal, comprising a line delay array having a plurality of taps and first combination means serving to generate a first linear combination of delay taps in which chrominance is suppressed, wherein the line delay array is line–locked and said first linear combination therefore contains residual chrominance, characterised in that second combination means are provided to generate a second, independent linear combination of delay taps representative of said residual chrominance and wherein said first and second combinations are mixed at appropriate phase and amplitude to cancel said residual chrominance.

2. Video signal processing means according to Claim 1, wherein said first linear combination comprises the sum of taps separated by two lines and said second linear combination comprises the difference of the said taps, phase shifted and attenuated.

3. A method of removing residual chrominance error from the output of a vertical filter operating at fixed line length, comprising the steps of independently deriving from the taps of the filter a signal representing the residual chrominance error and combining said signal with the filter output in cancellation of the error.

4. Video signal processing means substantially as hereinbefore described with reference to and as shown in Figures 3, 4 and 5 of the accompanying drawings.

5. A method of removing residual chrominance error substantially as hereinbefore described with reference to Figures 3, 4 and 5 of the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(T. Search report)

Application number
GB 9419280.4

Relevant Technical Fields

(i) UK Cl (Ed.M) H4F - FEK, FHS

(ii) Int Cl (Ed.5) H04N - 9/78

Search Examiner
D H JONES

Date of completion of Search
15 NOVEMBER 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI

Documents considered relevant following a search in respect of Claims :-
1-3

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

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